The Air Line Pilot

MAY 14 1957

A Pilot's Experience With Turbo Power

Ground And Flight Training To Master Basic Differences In Characteristics Are Vital. Main Operational Factors Are Higher Speed, Fuel Consumption, Meteorological Conditions

By Capt. J. T. A. Marsden, BOAC
British Air Line Pilots Association

I have decided to deal with this subject in two parts:

▶ First, the training side as a conversion course, and

▶ Second, the operational aspects of turbine-powered aircraft.

I do not intend to differentiate between turbo-props and pure jets, since there are only differences to a degree and not in principle. The pure jet aircraft fly higher, faster and have a greater fuel consumption than the turbo-prop aircraft, but then, so do the latter compared with piston-engined machines.

Training

The ground school should commence with a study of turbines and their characteristics. This should be fairly general in nature but with a bias towards the type of engine the pilot is going to use. We call this a "Basic Gas Turbine Course." It is here where he learns the principles of a turbine engine. He must learn all about the variables; the effect of temperature and height on his power. He must become aware of what we call "fuel philosophy." In this first week of his training, the pilot learns a new set of rules which he will find himself applying throughout his future career on turbines.

Because fuel is going to play such a large part in governing the pilot's decisions, he should have a thorough knowledge of flight planning/cruise control before he commences flying. He must be taught the effect on range caused by such things as: bad engine handling, engine failure, de-icing equipment, incorrect altitude, extra fuel uplift, etc.

My colleagues and I built up our experience of these factors while flying operationally. Later, we were able to teach the newer pilots, much easier, on the simulator, with very great effect. For that reason, I strongly recommend simulator training, especially the route flying as a crew, where the unexpected can be fed in and the correct subsequent actions taught. The results of bad decisions are much more appreciated too.

Training Program Aspects

With regard to the flying training program, there are two aspects which need special attention.

▶ **Aerodynamic Cleanliness:** This is immediately noticeable by the way the aircraft accelerates with small increase in power and/or loss of height, also the difficulty of deceleration. Obviously this is a feature which is overcome by training and experience but it is probably the largest obstacle to overcome. I well remember how it caught me out during my first take-off in the Comet. Not being used to the high angle of attack, I failed to stop the acceleration at the initial climbing speed of 260 Kts. and by the time we were at 1500', the speed was over 300 Kts.

The cleanliness of the aircraft is a characteristic which must be mastered by the pilot early in his training especially during the final approach and landing maneuvers. Until the technique necessary to cope with the aircraft's reluctance to decelerate is grasped, he will never know where the touch down point is going to be. This tendency to float will extend the landing distance if it is under-estimated, or can be the cause of an accident due to an undershoot, if it is over-estimated. It follows, therefore, that the pilot requires ample practice in order to perfect his judgment in this respect. His training does not cease when he is finished with the school, he must concentrate on his technique and improve where necessary for some time afterwards.

You may ask, "Do air brakes make it easier?" The air brakes on the Comet were most effective at high speeds, but the effectiveness was reduced as the speed reduced so that at approach speeds they made no difference at all. Air brakes are not fitted to the Britannia.

▶ **Engine Rate of Acceleration:** Most turbine engines either have the rate of acceleration governed automatically, or the pilot is ordered to act as the governor by opening the throttle at not greater than a certain rate. There may be a combination of both. This is necessary to prevent compressor stalling, extinctions, and excessive J.P.T's. The net result is for changes in engine power to be achieved somewhat slower than with piston engines. Here again is something new for the pilot to master during his training period. It affects

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The deHavilland "Comet."

the aircraft handling in the following manner:

If it is appreciated on the final approach that an increase in power of a certain increment is necessary and the application is too slow, then a much larger increment will be needed. The same applies to power reductions. I always tell the trainees that the time to make a power change is when the thought first enters their minds that they might need an increase or decrease later on the approach. If they wait until later, the amount of change may well be doubled or trebled.

With a piston-engined aircraft, when the throttles are closed during the landing flare-out, the propellers act as a very good brake. Not so however, with the pure jet and free propeller turbines. In the former case the props are absent and in the latter, the props, being free and not driving an engine, the braking effect is nil. Also, when the throttles are at "idling R.P.M.," there is still a considerable amount of thrust produced. This residual thrust added to the aerodynamic cleanliness produces a landing problem which is entirely related to turbine-powered aircraft.

Whereas the cleanliness factor is reasonably constant within the threshold speed band, the residual thrust can be variable according to the nature of the approach. The higher the power which is set up before the throttles are closed to "idling," then the longer will be the run-down period and the greater will be the residual thrust. It follows that landing distances will be variable.

We have evolved a technique which makes approaches simpler, especially instrument approaches. Instead of flying the aircraft at a constant airspeed and regulating the descent with engine power; we maintain a constant power and fly the aircraft within a speed band. Thus power need only be altered when either of the limiting speeds of the band is reached and further effect is required.

Once the pilot is competent in respect of these two fundamental changes in the aircraft's characteristics, then a turbine-powered aircraft becomes just another machine so far as handling is concerned.

Instrument Flying

This subject is worthy of a few words, since although instrument flying in a jet is as pleasant as in any other aircraft, it is not so initially.

A few years ago a Sperry pilot visited the U.K. and gave a good lecture on the Zero Reader, which is an instrument I like very much. However, he remarked that the Vertical Speed Indicator (V.S.I.) was outmoded and if it was not thrown out altogether, then it should be located behind the pilot's head. In the Comet I, it was fitted at the bottom of the main instrument panel and was obscured from view by the control column. We very quickly found however, that the V.S.I. was one of our most important instruments. There are two reasons, the first is operational and I will cover that aspect later, the second is due to the sluggishness of the A.S.I. and altimeter. When the aircraft departs from its flight path in elevation, it does not immediately change its speed, therefore, apart from any lag in the instrument, the A.S.I. remains constant for a period of time. The altimeter does not register

The Bristol "Britannia."

the change of height nearly as rapidly as it is taking place. Thus, the instrument which indicates a change within a reasonable time, is the V.S.I.

It will be appreciated that small changes in pitch, which may be hardly perceptible on the artifical horizon, have much more effect on the flight path at the higher speeds and cause a greater rate of change of height than the same pitch movements at the slower speeds.

The V.S.I. should be given a prominent position on the instrument panel.

Operational Aspects

There are three main factors and their associated problems which demand greater attention than has been given hitherto. These are:

(1) The increase in speed.

(2) The increase in fuel consumption.

(3) Meteorological Conditions.

▶ **Speed:** Depending on the type of aircraft, the speed may be increased by 50 per cent, 100 per cent, or 200 per cent. However much it is increased, the first consideration will be the control of the aircraft.

The manufacturers will incorporate devices designed to reduce the chance of the pilot overstressing the machine at high speeds thereby causing structural failure. These may take the form of "Q" feel to restrict the rate of elevator movement proportional to airspeed, or reduced elevator range, or both. Ailerons may be treated similarly. However, the problem still remains and the pilot must be conscious of the possibility of over-controlling, especially in turbulence. One must learn to develop the habit of always moving the controls slowly, never to snatch, no matter how great is the temptation. It is also advisable to keep ones feet away from the rudder pedals except during the take-off and landing maneuvers. This will prevent any natural, impulsive, corrective action with the onset of sudden turbulence.

This brings me to handling in severe turbulence. It is now more important than ever to prepare the aircraft before entering highly turbulent cloud. The airspeed must be correct. We carried out an enormous amount of Cu. Nb. flying with the Britannia during the icing trials. No difficulty was experienced at all with handling, provided the penetration speed was set up prior to entering and the aircraft's attitude maintained constant.

The second consideration of speed is, of course, the tempo on the flight deck. This is proportional to speed and is influenced by the methods of navigation and communications used by the operator or demanded by the Air Traffic Control. It follows that the tempo is highest on high density airways. This can be improved if the reporting points are reduced.

A.T.C. authorities must appreciate the difficulties inherent when the aircraft is covering the ground at a speed of 6 to 10 miles per minute.

Another consideration is the increased radius of turn. No longer can the pilot carry out Rate I turns because the angle of bank is too high, he must limit his turns to rate ½. The following figures indicate this point for a T.A.S of 500 Kts:

Rate I turn = 53° angle of bank and a radius of turn of 2¾ NM.

Rate ½ turn = 34° angle of bank and a radius of turn of 5⅓ NM.

Even with a T.A.S. of 300 Kts., an angle of bank of 38° is too high for passengers' comfort, so rate ½ turns are necessary.

In order that the increased tempo can be accepted, a revision of procedures is necessary. Company and A.T.C. procedures need simplifying. All information required by the Captain to assist him in arriving at his decisions should be at his finger tips. Communications must be good. weather conditions at terminal and alternates must be in his possession well in advance of P.N.R., not 5 or 10 minutes ahead.

▶ **Increase in Fuel Consumption:** This is probably the most critical factor of all and whereas it is appreciated that "Two Spool" turbines will be more flexible in the future, the present day engines are not so.

Cruise control is no more than pilot technique. Once the route and height have been chosen during flight planning, control is achieved by adherence to that plan.

There is one strict rule: never reduce height for anything other than emergency reasons. If you do, then the fuel consumption will increase and that increase must come out of the reserves.

With the Britannia we carry out a fast, level cruise procedure. The height is chosen according to the aircraft's weight and the air temperature so that the airspeed has built up by the end of cruise to the normal maximum permissible. In this way, our flexibility so far as height is concerned, is upwards. If the "economical" method had been chosen, which is a "high stepped" cruise, then there is no flexibility at all.

Another advantage, which satisfies A.T.C. is that in the event of an engine failure during a fast, level cruise, the aircraft is already at the 3-engine height. If an engine fails during any other cruise procedure, then a "drift down" must be initiated to the 3-engine stabilized altitude, or the nearest quadrantal height below.

If the aircraft uses thermal methods of anti or de-icing, with the engines as a source of heat, then during flight planning, account must be taken of the possibility of icing conditions being met on the route. Additional fuel will be required, otherwise the range will be reduced and the reserves depleted.

It is interesting to recall that I never once had to use the de-icing system on the Comet. It became a debating point, because we climbed and descended through conditions most favorable for ice formation. The ice just did not seem to adhere to the aircraft.

Descents

The next problem is the descent. When the flight plan is made out, the descent will be calculated as a duration of time based on a rate of descent. As you know, there are three possibilities which may happen:

(a) If the actual average wind velocity is the same as forecast and the correct rate of descent is maintained, the aircraft will arrive over destination at the planned height.

(b) If, however, the W/V is more adverse, but the rate of descent is still correct, the aircraft will finish at a low height short of destination. If the rate of descent is reduced and the cor-

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On The Cover

TWA officials including the air line's new president Burgess joined with ALPA President Sayen, the TWA Negotiating Committee and the TWA Master Executive Council in ceremonies during mid-February, on the occasion of the signing of a new employment agreement between ALPA and the company.

This agreement, which recognizes some concepts for the first time and extends others on which the Association has been working, was concluded only nine days after the duration date of the prior contract, is effective for 18 months, and covers TWA's domestic and international operations.

Karl Ulrich 1902-1957

'To Fly West, My Friend, Is A Flight We All Must Take For A Final Check'

The entire Association suffered a great and distinct loss on April 9, when Karl Ulrich, veteran ALPA staff member, was stricken with coronary thrombosis and passed on suddenly.

Funeral services were held in Miami, April 13, with long-time pilot friends, Association officers, representatives of management and relatives paying their last respects. Surviving is his wife, Pauline.

Karl had completed more than 14 years of loyal, conscientious and important service to the Association at the time of his death. He was 54 years old and, in length of service, the Association's second most senior employee. He played an important role in the development of the Association in which he took a dedicated career interest.

Karl began his employment with the Association on September 27, 1943. For several years, he was a one-man Negotiating Department. As a negotiator, Karl was instrumental in securing some of the first employment agreements of the Association. In addition, for a number of years, he also served as the Association's staff personnel director.

Early in 1956, Karl was loaned to the Canadian Air Line Pilots Association to assist them in negotiating their first formula-type agreement, a job which was successfully concluded and drew the high praise of CALPA.

Since June, 1956, he had headed ALPA's Miami Regional Office. Prior to that he served as head of the New York Regional Office.

Ulrich was born in Waterloo, Iowa, May 20, 1902, and attended Loyola University. His wide business background, prior to joining the ALPA staff, included ten years of service as an arbitrator in the Department of Labor of the State of Illinois.

Karl was known and respected throughout the industry as a hard, but fair, negotiator and a staunch and uncompromising champion of the interests of air line pilots. Karl was noted for his friendly and unselfish personality, and, beyond being an employee of the Association, was a long-time personal friend of many pilots who knew they could call upon him whenever they had a problem. In a hard business, many of the management representatives with whom he traded blows across the conference table, nevertheless remained his friends. Whatever his assignment, Karl accepted it willingly and gave it his best.

Many pilots recall that Karl often went far out of his way, and beyond the call of duty to do them a favor.

Suffering from a heart condition for some time, Karl had been advised to slow down, but he preferred to remain in harness.

Bobby Rohan, ALPA Region II Vice-President, paid Karl this tribute:

"A loyal, hard-working Association employee took his last flight West. He gave much to air line pilots and their cause. He devoted many months of his fast waning life to the pursuit of National Air Lines' problems and others in the Miami area. In his devotion to pilots and pilots' affairs, well knowing the risk he undertook, continued to work his heart out in the pilots' behalf."

President Sayen said: "Karl was one of ALPA's most devoted and competent employees, to whom many pilots owe a deep debt of gratitude for his efforts in their behalf. His passing is a deep blow to all of us who knew him personally and a grievous loss to the Association."

Professional Standards For Air Line Pilots

As A Professional Group We Must Establish Standards Of Conduct And Live Up To Them. Pilots Recognize This Responsibility And Are Ready To Accept It, A Convention Report

Several important steps were taken by the Board of Directors at the Fourteenth Convention defining and placing greater emphasis on the professional aspects of air line piloting.

These actions were the result of an extensive period of study carried on from June, 1955, to November, 1956, by a specialized committee—the Professional Standards Study Committee—established by the Board of Directors to conduct studies and make recommendations on "the establishment and maintenance of adequate professional standards for air line pilots."

Covers Two Areas

Essentially and generally, they covered two areas:

- Professional standards at the group level, or, organizational level—the Association, Master Executive Councils, and Local Executive Councils.
- Professional standards at the individual pilot level.

Specifically, the Convention adopted resolutions:

- Establishing a code of ethics and canons for air line pilots.
- Establishing a Professional Standards Committee as a standing Committee of the Board of Directors.
- Establishing professional standards committees in the Local and Master Executive Councils beginning on May 1, 1957.

Code Of Ethics

The code of ethics, adopted by the Board of Directors, covers the following statement of principles:

- An Air Line Pilot will keep uppermost in his mind the safety, comfort and well being of the passengers who entrust their lives to him and are his first and greatest responsibility.
- An air line pilot will faithfully discharge the duty he owes the air line which employs him and whose salary makes possible his way of life.
- An air line pilot will accept the responsibilities as well as the rewards of command, and will at all times so conduct himself both on duty and off as to instill and merit the confidence and respect of his crew, his fellow employees, and his associates within the profession.
- An air line pilot will conduct his affairs with other members of the profession and with the Association in such a manner as to bring credit to the profession and the Association, as well as himself.
- To an air line pilot, the honor of his profession is dear, and he will remember that his own character and conduct reflect honor or dishonor upon his profession.
- Having endeavored to his utmost to faithfully fulfill the obligations of the Air Line Pilots Association Code of Ethics and Canons for the Guidance of Air Line Pilots, a pilot may consider himself worthy to be called—an air line pilot.

Professional Standards Committees

Functions of the Committees established within the professional standards realm are:

- Professional Standards Standing Committee: To conduct a study of methods necessary to maintain worthy professional standards and determine goals to be attained in the future.
- Local Executive Council Professional Standards Committee: Will have the primary function of assisting the professional copilot in attaining his professional training, to investigate and to evaluate the applicant's qualifications for membership in the Air Line Pilots Association. Their secondary function will be to handle all problems of a professional and ethical nature between the pilots in the Local Council and to make recommendations to the Local Executive Council as to the disposition of such cases with any action taken being the responsibility of the Local Executive Council.
- Master Executive Council Professional Standards Committee: Will have the responsibility of coordinating the activities of the Local Professional Standards Committees and to study cases that are referred to them by the MEC and recommend disposition of such cases with any action taken being the responsibility of the MEC.

Studies Instituted In 1955

Work on professional standards studies and research was instituted by the Executive Committee at its June 1-3, 1955, meeting when it adopted the following resolution:

> "WHEREAS, the nature of the air transport industry makes necessary the establishment and maintenance of adequate professional standards for pilots to promote the growth and strength of the piloting profession, and
>
> "WHEREAS, the maintenance of such pilot standards is a prime responsibility of the air line pilots themselves, and
>
> "WHEREAS, self-policing and maintenance of professional standards is a most effective means of insuring against interference by outside and often incompetent groups in this field,
>
> "THEREFORE, BE IT RESOLVED, that a recommendation be made to the Board of Directors to develop a program to insure the maintenance of professional standards in the selection and training of air line pilots."

The Board of Directors approved the creation of this standing committee and the Executive Committee on September 12, 1955, selected the following members: C. A. Peternell, United Air Lines; C. E. Colbath, Allegheny Airlines; W. C. Root, Braniff Airways; O. C. Ross, Capital Airlines; W. F. Saul, Pan American World Airways. W. M. Masland, PAA, served as consultant. The Committee produced a 35-page report and recommendations which were submitted to the Board of Directors at the Convention.

Need For Professional Standards

In the report which it produced, the Committee pointed out the need for measurable guides against which to measure professional standards.

"Generally speaking," the Committee reported, "when Mr. John Q. Public thinks of airplanes and airplane trips, he thinks of pilots. He probably thinks of every pilot he has ever known or known of, lumps the total and comes up with a man. Then, based on the type of man he pictures in his mind, he trusts his life and the lives of his family to an airplane piloted by that kind of guy, or he takes the train.

"Does he have the right picture? Who knows? No-one has given him a standard to picture in his mind which he will accept or has any justification to accept. We have given him nothing to measure us by except personal contact and what he reads in the papers.

"The aviation industry has grown at a fantastic, unparalled pace until today it has become a major, world-wide transport medium which carries millions of passengers and thousands of tons of goods every year. However, the aviation industry has just begun to tap the vast travel market which it has created. Complete acceptance of air travel by the general public will come only through confidence. It will grow with each generation, but it will remain a perishable attitude until the traveling public can accept with assurance that a consistent standard of professional training, personal integrity and moral responsibility is required for a man to become a member of the piloting profession and to maintain that membership.

"The Air Line Pilots Association has been an active part of the air line industry for the past twenty-six years. We have established and built up a respected association of pilots. We have increased our prestige and effectiveness immeasurably within the last five years, but we have not established ourselves as a professional group nor are we recognized as such by others within or without the industry. It is time that we strove for such recognition and, in fact, became a professional association."

Professional Responsibility

The Committee also made an extensive study of what constituted a profession and the concept of professional responsibility. In this respect, it reported:

"We believe that all pilots, whether or not they have ever consciously thought of it, regard themselves as craftsmen. R. M. MacIver, in *The Social Significance of Professional Ethics* says, 'The spirit and method of the craft, banished from industry, finds a more permanent home in the professions. Here still prevail the long apprenticeship, the distinctive training, the small-scale unit of employment and the intrinsic—interest alike in the process and the product of the work.' Every organized profession avows itself to be an association existing primarily to fulfill a definite service within the community. A full-fledged profession is a vocation in which the following conditions exist: (1) pursuit of the vocation demands that practitioners acquire an intellectually based technique; (2) practitioners assume a relationship of responsibility toward clients or the general public; (3) practitioners are organized into responsible associations which set standards for admission to practice and exert control over the actions of their members through codes of ethics. In most professions, the social control exerted by the association is reinforced by public licensing and supervision. The concept of 'profession' implies, essentially, a particular form of *control* over the conduct of the practitioner. When we speak of professional conduct, we refer to actions of a practitioner which are consistent with the accepted code of his group. Professionalism is, in other words, a form of social control over the behavior of individuals. For their own welfare the professions need to support intensive investigations of their own history, their behavior, and their problems. Walter Reuther said, 'No man or organization is mature until willing both to tolerate and to encourage analysis and criticism.' 'It is part of the pessimist myth of our times that the seer and the visionary are without followers, that the appeal to ideals must fail, whereas the appeal to self-interest is universally invincible. Yet it is clear that in human affairs, yesterday's idealistic commandments often become today's laws and are tomorrow translated into action.' (Morris L. Cogan, *The Problem of Defining a Profession.*) The Ten Commandments, the Sermon on the Mount, and the Golden Rule were all regarded as revolutionary ideas at the time they were first pronounced."

Reasons For Code Of Ethics

The establishment of a code of ethics, it was pointed out, is basic to recognition of a profession.

"It will be readily understood that in a rapidly growing profession new problems of professional conduct constantly occur," the report stated. "To devise a code of ethics good for all time is neither practical nor desirable. A code of ethics should not be inviolate and unchanging. Moral truths may be unchanging but their application varies as social and economic factors change. The Air Line Pilots Association has a code of ethics, adopted at the Ninth Convention in February, 1947. Its statement of general principles is excellent. We have no quarrel with it. But we believe that the time has come to restate our principles in more practical terms, so that they may serve as a real guide to those in the profession now and those who will join it in the future. Dr. Landis has made a sociological analysis of professional codes and has concluded that the optimal control of ethical behavior is generally achieved by those professions that have set up the machinery for control based on 'a code containing clear definitions of situations.' "

"The Professional Standards Committee has studied the codes of ethics of all the professions, including those of the various engineering societies, whose aims and problems appear to be most like our own. As some of the other professions have done, we have first stated broad principles in the areas where we conceive our basic responsibilities to be—to the flying public, to the various air lines that employ us, to our crews and fellow employees, to our associates within the profession, and to the communities where we reside—and the five paragraphs containing these statements of our principles can well stand alone as our creed, the Code of Ethics of the Air Line Pilots Association. But in order that they might be a more practical guide in the every-day conduct of our professional lives, we have added Canons for the Guidance of Air Line Pilots, which together form practical working rules we can live by, and by which Mr. John Q. Public can measure us as professional men.

"These principles are intended to serve the air line pilot as a guide to ethical conduct. They provide a sound basis for solution of many of the problems which arise in his responsibilities and relationships to his passengers, his crew and fellow employees, his fellow pilots, the Association, and to society as a whole. They are not laws designed to govern the air line pilot. Rather,

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A Council Chairman Finds A Friend

A Chairman knocked at the heavenly gate,
His face was scarred and old,
He stood before the man of fate for admission to the fold.

"What have you done," St. Peter said,
"To gain admission here?"
"I've been a Council Chairman, Sir
For many and many a year."

The pearly gate swung open wide,
St. Peter touched the bell . . .
"Come in and choose your harp," he said,
"You've had your share of hell."

Evaluation Of Altimeter Position Errors

Errors Are Inherent In Pressure Altitude Systems, Says The Author. The Operational Accuracy Of Pressure Altimeters Will Strongly Govern Degree Of Air Space Utilization

By Jack H. King
Wright Air Development Center

With the tremendous increase in the volume of air traffic and the higher operating altitudes and speeds of modern aircraft, there is an increasing amount of concern relative to the actual vertical clearance between aircraft operating over the same route under IFR conditions. As we know, current CAA regulations require, under IFR conditions, that aircraft be separated vertically by 1000 feet up to 30,000 ft. pressure altitude and by 2000 feet above that altitude. It is obvious that the accuracy of the altimeter and altimeter system available plays a large part in the actual clearance obtained under operating conditions. The rapid increase in the volume of air traffic has caused another problem to arise, namely that if current vertical separation intervals are maintained the result will be inadequate air space available for separation of aircraft under traffic control conditions. Therefore, the operational accuracy of pressure altimeter systems will strongly govern the degree of air space utilization.

Research Cited

A large amount of research and development work has been done and is being done on the various errors which are inherent in a pressure altitude system. At a meeting in February 1956 of the Panel on Vertical Separation of Aircraft of the International Civil Aviation Organization, the Panel attempted to define the types of errors which are present. The result of their meeting indicated that there are four basic types of errors. These errors, not necessarily in order of importance, are:

▸ **Mechanical errors:** This includes errors resulting from the mechanical limitations of the instrument such as diaphragm error, hysteresis error, temperature error, etc.

▸ **Errors of basic principle:** These are errors caused by the methods which are used to convert pressure into height indications such as the use of a standard atmosphere and the use of different pressure data by aircraft in the same vicinity.

▸ **Additional factors:** These are errors which involve the size of the aircraft and the accuracy with which a desired flight level can be maintained.

▸ **Operation and installation errors:** These are errors which result from the way that a pressure altimeter is operated and the accuracy with which it can be read. Included in this type of error is the position error, due to location and type of pick-up used, of the altimeter pressure sensing system. Determination of this position error for a large variety of aircraft was the primary purpose of the flight test program which was conducted by the Wright Air Development Center.

SC-70's Tasks

The initial request for this program originated with Special Committee 70 of the Radio Technical Commission for Aeronautics, Washington, D. C. This committee was given the task, in July 1954, of studying the problems associated with the measurement of pressure altitude. The study was to cover the assembly of pertinent information on altimetry, particularly with regard to the accuracy and reliability of the various methods, to determine the operational requirement with respect to the accuracy needed and to study methods of measurement which would approximate or meet the operational requirements.

In early 1955, this committee determined, after a review of the existing data relative to altimeter installation errors, that there was insufficient data available to conclusively establish the magnitude of the installation error and to determine the repeatability of this error from aircraft to aircraft of the same type and configuration. Therefore, in June 1955 the RTCA recommended that a flight test program be initiated to obtain accurate data relative to the magnitude and repeatability of altimeter system position errors for all types of civil and military aircraft employed in IFR operations. It was further recommended that the U. S. Navy and Air Force calibrate their respective military aircraft and provide calibration facilities to the scheduled air carriers for the civil aircraft.

As a result of the RTCA recommendations, the U. S. Air Force established a flight test program in January 1956 with the Wright Air Development Center designated as the responsible agency for the conduct of the Air Force phase of the testing. The Air Force Flight Test Center, Edwards Air Force Base, also assisted in the program.

Test Procedures

Representative military and civil aircraft which are ordinarily operated under IFR conditions were selected for calibration. The list of aircraft types used totalled 39 and included 27 USAF and 11 civilian models. When possible, a total of three of each type of aircraft were calibrated. The civil aircraft used were the CV-240, 340 and 440, the B-377, the DC-6, 6A, 6B and 7, the M-404 and the L-749, and 1049G. These civil aircraft were furnished by the scheduled air carriers and the pacer aircraft used were furnished by Wright Air Development Center and the Air Force Flight Test Center.

Technique Used

Two traveling calibration teams were formed to accomplish the required testing, one from WADC and one from the AFFTC. The team from WADC covered bases in the eastern section of the country and the team from the AFFTC covered the bases in the western section. The two teams, in general, consisted of an F-86E pacer aircraft for high speed work and a C-45 which was used as a low speed pacer in addition to being used as transportation for the team members and equipment. For some of the WADC pacing, a T-28 pacer was also used for low speed calibrations.

Arrangements were made in advance for the required aircraft to be available and properly loaded for the calibration tests on the scheduled date. The Air Force and civil bases had instrumentation mechanics available for the installation of calibrated airspeed and altimeter instruments in place of the standard ships instruments. These calibrated instruments were furnished by the calibration team which also supervised their installation and checked the aircraft for proper configuration and

Commercial Aircraft Flight Calibration Test Data

Type A/C	No. Calibration	Speed Range Calib at 10,000 Ft. — Knots	Handbook Error — Ft.	Error In No. 1 A/C — Ft.	Error In No. 2 A/C — Ft.	Error In No. 3 A/C — Ft.	Max. Variation Between A/C — Ft.	Max. Variation From Handbook — Ft.
240	2	120 to 210	+40 to +10	+70 to +205	+100 to +70	—	135@ 210 kts	195@ 210 kts
340	3	120 to 210	+20 to +5	−20 to −20	+5 to 0	−40 to −150	150@ 210 kts	155@ 210 kts
440	2	125 to 195	+30 to +20	−35 to −95	−45 to −105	—	10 ft. @ all speeds	115@ 195 kts
404	3	125 to 205	−10 to −65	−30 to −65	−35 to −100	−80 to −140	45@ 125 kts	75@ 205 kts
DC-6, 6A, 6B	3	120 to 240	+20 to −210	−10 to −210	−50 to 210	−80 to −190	70@ 120 kts	100@ 120 kts
DC-7	3	130 to 260	+30 to −120	−50 to −90	−20 to −120	0 to −50	70@ 260 kts	80@ 120 kts
377	2	120 to 230	−60 to −30	−60 to −50	−100 to −190	—	140@ 230 kts	160@ 230 kts
749	1	130 to 235	+65 to +30	+85 to +105	—	—	—	75@ 255 kts
1049G	3	120 to 240	−50 to −70	0 to −60	0 to −70	−30 to −110	40@ 190 kts	40@ 190 kts

weights. A preflight check was also made to assure that there were no leaks in the airspeed or altimeter systems. The pilots and crews of the aircraft to be paced were briefed by the team engineer and pacer aircraft pilot to assure of complete understanding of the in-flight procedure to be followed.

The actual flight calibrations were obtained at one altitude (approximately 10,000 feet), with gear and flaps up and throughout the normal speed range of the particular aircraft under IFR conditions. The calibrations were obtained by having both aircraft climb to the desired altitude and establish straight and level flight. The aircraft to be calibrated then established the desired stabilized speed with the pacer in close formation. When both aircraft were stabilized "on speed" in formation, the airspeed and altimeter were read in both cockpits. This procedure was repeated at the desired number of speed points throughout the range to be calibrated. The team engineer then collected the data and after examination it was returned to the home base for analysis and plotting.

Data Obtained

The data that were obtained during this program were analyzed and reduced in the following manner: Since the instrument and position error of the pacer was known, the actual pressure altitude was easily obtained. After the instrument error was applied to the instruments in the paced airplane, the position error in terms of altitude was computed by taking the difference between the known pressure altitude and the instrument error corrected altitude. The altitude position errors were then plotted versus indicated airspeed and curves were drawn to fit the points. The data was then extrapolated to sea level and to the maximum cruising altitude. The method of extrapolation to other altitudes depended on the characteristics of the aircraft and the static pressure system. For low speed aircraft with no Mach No. effects it was assumed that the errors were only a function of angle to attack. In this case, for a given calibrated air speed and gross weight, the altimeter error in terms of pressure increments should be constant. The position error in feet can then be determined at the altitudes desired by using the pressure increments determined in the original calibration. For higher speed aircraft where the position error is affected by Mach No., this must also be taken into account in the extrapolation.

Analysis Of Data

Since you are primarily interested in the commercial aircraft which were calibrated I will confine most of my discussion of the result to these aircraft with just some general remarks on the military aircraft tested. As stated previously, there were a total of 11 types of civil aircraft tested. I have attempted to summarize the data obtained in the accompanying table in terms of aircraft, the speed range which was calibrated, and the maximum errors obtained.

The data obtained were analyzed in the following manner: For correlation with the Handbook values a difference of 50 ft. or less was considered good, 50 to 100 ft. was considered fair and greater than 100 ft. was considered poor. For correlation between aircraft a difference of 100 ft. or less was considered good, from 100 to 200 ft. fair and over 200 ft. poor. On this basis, the correlation with the handbook data of the 749, 1049G, DC-6, 6A, 6B and the 404 was fair to good. For the other aircraft, it was poor for at least one of those tested. Correlation between aircraft was good for the 404, the 440, the DC-6, 6A and 6B, the DC-7 and the 1049G. For the rest of the aircraft tested it was fair. In general then, it could be said that the majority of the aircraft tested correlated satisfactorily with the handbook and with other aircraft of the same type. Also, it should be noted that in practically all cases the handbook values reflected smaller installation errors than those actually encountered.

Instrument errors of the altimeters being used in the aircraft tested were obtained in most cases. These errors varied generally at 10,000 feet from plus to minus 50 feet. Several altimeters had larger errors than this, with the largest error being—160 feet on one instrument.

As for the military aircraft tested, in general, the correlation results were similar to the results of the civil type with most aircraft showing fair to good correlation. It should also be noted, though, that in the high speed aircraft which are subject to Mach No. effects the actual value of the errors was considerably higher, at high speeds, than for the civil type. The largest error obtained, in the speed range tested and at 10,000 feet, was 600 to 800 ft. with the F-84G aircraft at 400 knots.

The complete data obtained on all the aircraft tested was put into report form and forwarded to the Radio Technical Commission for Aeronautics in Washington and will constitute one phase of their study.

Development Work At Present

It is apparent from the results of this program that there is a consider-

able amount of room for improvement in the measurement of pressure altitude. Several different aspects of this problem are being investigated at the present time.

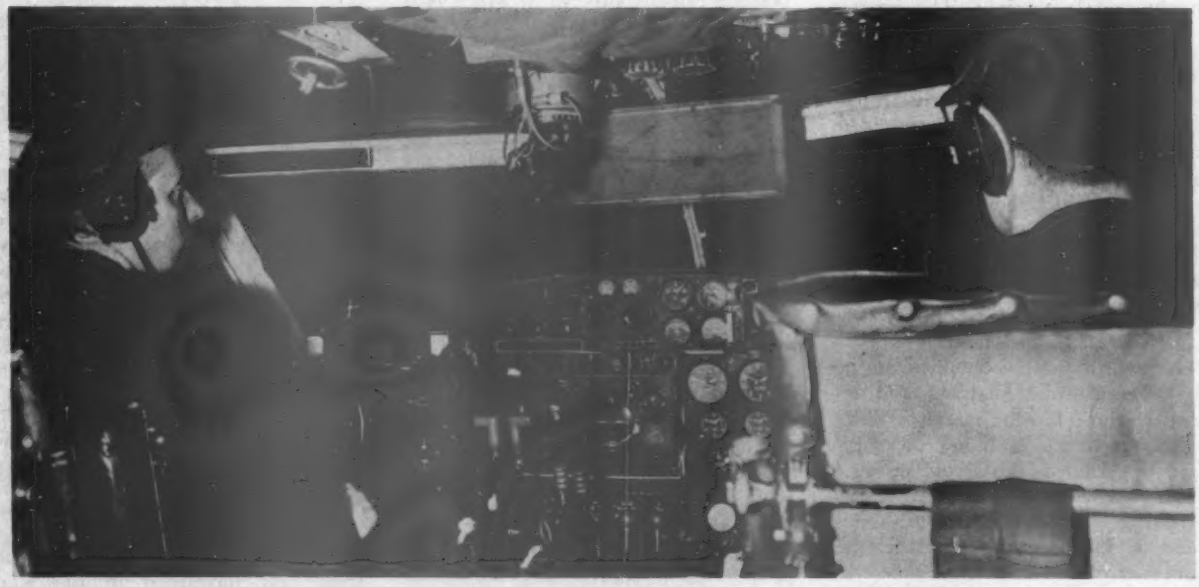
First, there is an attempt being made to significantly improve the instrument error inherent in the altimeter itself. Development programs are currently being conducted to obtain altimeters which will give an accurancy of plus or minus ¼% of the indicated altitude plus 20 feet. While altimeters of this type are not available now, it is hoped that they will be in the future. Further development work is also planned to further reduce these errors.

Secondly, work is being carried out to determine if there is an optimum location on an aircraft where the position error will be significantly less than the errors which are now present. The success of this program, in terms of obtaining relatively insignificant position errors, is somewhat doubtful. It was concluded from a study conducted under contract by the University of Southern California that there is no single location on transonic or supersonic aircraft that will give indicated pressure within 1% of the true free stream value. Also, at transonic and supersonic speeds the large pressure extremes existing within the flow field cause appreciable errors at even the most favorable locations, notably the use of either a wing or nose boom type of installation.

A third, and more immediate approach to this problem is to utilize a static pressure source location on an aircraft which is convenient but not sufficiently accurate and provide some form of automatic compensation which will correct the inaccurate source to the required accuracy. In connection with this approach to the problem, several static pressure compensator programs have been initiated by the Flight Control Laboratory of the Wright Air Development Center. The compensators involved would be of an electromechanical nature and be designed to correct the aircraft position error as determined by flight test.

It is apparent that the third method proposed, that of a compensating device, can be no better than the accuracy with which the position error calibration of the aircraft concerned is originally obtained. Considerable effort is now being put forth to determine means by which the calibration can be made as accurate as possible. The methods currently used to originally calibrate a pacer aircraft consist essentially of a fly-by type of calibration whereby the altimeter in the test aircraft is compared to a reference calibrated altimeter either on the ground or in another aircraft. A ground speed course can also be used, but this is not practical for a high-speed aircraft. Once the pacer is calibrated it is used to calibrate other aircraft either by flying in formation with the other aircraft or by using the fly-by technique.

A survey was recently made of the various test centers, the NACA, and various aircraft manufacturers. The results of this survey indicated that the fly-by method or some variation of this is currently being used by all concerned and it is felt that this method is the most practical and accurate method presently available. The accuracy of the method itself can be improved by very careful choice of instruments and technique used. Within the next few months we hope to put out a research contract to explore the area of air speed calibrations more extensively with the hope that a more accurate method or methods can be determined.



Decca Navigation System

This navigation aid designed to pictorially show the location of aircraft with relation to ground fixes, is scheduled to undergo operational evaluation in the New York area with the assistance of New York Airways. Shown above is the Decca Navigator Mark 9 Receiver, with fixed flight log, on a British Silver City Airways' Bristol Freighter. It gives accurate position reports at all times to ensure safe separation of aircraft and avoidance of terminal delays on the airline's high density English Channel ferry services.

State Of The Association

Part 5

(EDITOR'S NOTE: *This is the fifth and final installment of* THE STATE OF THE ASSOCIATION REPORT *submitted by President Sayen at the Fourteenth Convention, highlights of which are being reprinted due to many requests for publication of this information. This installment covers the* Status Report on 13th Convention Actions, *and an outline of* Current Problems and The Future. *The figures employed are as of October 1, 1956, when the report was written.)*

Status Report On 13th Convention Actions

The following is an outline of the actions taken by the Board of Directors in the 13th Convention in 1954 and current status of their implementation. A more complete statement of the actions is found in your Policy Manual and current implementation is reported in the *News Bulletin,* THE AIR LINE PILOT, other ALPA releases, and on request.

By-Laws And Organization

Convention actions on the following subjects have been incorporated in the By-Laws:

- Clarification of By-Laws on Subject of Suspended Members;
- Establishment of Time Limits for Hearing Charges;
- Revision of By-Laws Nomination Procedure;
- Status of Accused ALPA Members under Appeal Provisions;
- Transfer of AA Council No. 93 to Region I;
- Transfer of Bonanza Air Lines Council No. 107 from Region IV to Region V.

Implementation has been accomplished of the following two policy determinations:

- Majority required on Association Ballots;
- Secret Balloting.

The following two policies relating to departmental organization have been accomplished as indicated:

- *Expansion of Engineering and Air Safety Department:* Work has been underway to expand the functioning of this phase of the Association's activity. This has largely taken the form of increased pilot participation through flight pay loss. On special projects, pilot specialists are continued on a specific project until completion, with flight pay loss and expense borne by ALPA. In some instances, pilots have been put on restricted flying status of 40 hours per month in order to make help available for this work.

An additional staff member specifically assigned to Engineering and Air Safety work has also been assigned to the Washington office and another professional staff man will shortly be added to the Home Office.

- *Improvement of Representation in Washington, D. C.:* This problem is discussed under the Legislation section of this report. Briefly, Washington representation has been strengthened through an integrated program utilizing staff members and pilot representatives under a coordinated plan based on the desirability of as much pilot representation as possible.

In addition, another staff member has been employed in the Washington office to coordinate Air Safety and Engineering problems.

Employment Agreements, Rules And Working Conditions

Convention actions on the following subjects of a policy nature have been complied with by the Employment Agreement Department, and action taken as follows:

- *Eight-hour Flight Time Rule:* Flight Time Limitations and rest periods, as set forth in the Civil Air Regulations, have been incorporated into twenty-four agreements, largely as a result of the 8-hour dispute in 1954.
- *Expanded Employment Agreement Coverage On Working Condition Factors:* Provisions of Flight Time, On-Duty Time, Crew Complement, now set forth in regulations, are being incorporated into employment agreements at an accelerated pace.
- *Flight Time-On-Duty Time:* On-Duty restrictions are contained in approximately 18 agreements with 7 agreements tieing a definite relationship between on-duty time and flight pay and flight credit for pilots.
- *Negotiation of Passes for Pilot Representatives:* Efforts of the Association to process this problem by collective bargaining have not been successful to date.

The Convention resolution on System Board appointment procedure reaffirms the Eleventh Convention action requiring solicitation of MEC recommendations prior to appointment, which practice continued to be followed by the President's Department.

Wage Policy And Working Conditions Board

The Wage and Working Conditions Policy Committee, established by the Board of Directors at the Fourteenth Convention, held its first meeting, during April, at the Home Office. Shown l. to r.: R. O'Neill (NWA), J. E. Wood (EAL), T. Latta (AA), C. Barnes (UAL), J. C. Carroll (TWA), J. C. Christie, Head, ALPA Employment Agreements Dept., E. Tappe (CAP), C. E. Cochran (OZA).

Junior ALPA

Left: Three-year old John Sturdevant will have to wait a few years before he can wear the official wings of an air line pilot. Meanwhile, he's happy with Junior Pilot wings presented by UAL Capt. W. L. Thomas. John's dad also is a pilot with United. Below: This bright-eyed junior pilot is four-year-old Rowland, son of UAL Capt. Jack Hansen. Mother Betty and a neighbor fashioned youngster's uniform from Daddy's first UAL outfit, now 15 years old and outmoded. It's authentic even to an ALPA pin.

The ALPA Camera

ALPA Awards To Army Pilots

Fort Benning U. S. Army pilots were presented with awards at a recent honor guard at Lawson Army Airfield by J. P. Talton (EAL), former Reg. II V.-P. (left), for their assistance in rescue operations following last July's collision over the Grand Canyon. Maj. Gen. H. B. Powell, U. S. Army Infantry Center commander, is shown with Talton. Those honored, all members of the First Aviation Company (Fixed Wing-Tactical Transport) of Lawson Army Airfield Command, are l. to r.: Maj. J. B. Feldt, Capt. K. E. McGaughey, Capt. W. A. Strong, 1st Lts. K. R. Niederbach, R. A. Hudson, J. E. Ahern.

Hearings And Appeals Board

The Hearings And Appeals Board, a judicial branch of the Association's structure established by the 14th Convention, heard its first cases at the Home Office during April. Shown l. to r.: O. C. Ross (CAP), G. M. Corbett (CAL), F. A. Spencer (AA), E. A. Feazel (TWA), C. A. Stokes (SOU).

Accounting And Finance

Board of Directors' actions on the following four subjects have all been incorporated into the By-Laws of the Association and are being followed accordingly:

- Association Dues Structure and Financial Reserves;
- Dues for Supervisory Pilots;
- Increased Expenses for ALPA Pilot Representatives;
- Strike Assessment Payments by Supervisors.

The following resolutions requiring action were handled as indicated:

- *Payment of Dues on Bonus Income:* The Dues Committee met in 1955, evaluated this problem and transmitted its recommendations to the Executive Committee as directed, and is on 14th Convention agenda.
- *Contribution of Free Trade Union Committee:* This Board of Directors' action on contribution problems was referred as requested to the Executive Committee for action.
- *Expediting Flight Pay Loss Reimbursement:* Procedure activated by the Accounting Department.
- *Provision for Variable Council Petty Cash Funds Based on Council Size:* Activated by the Accounting Department.
- *Payment of Local Council Flight Pay Loss and Expenses in Cases Involving Charges and Hearings:* Included in Council operating expense policy for guidance of the Accounting Department.
- *Reimbursing ALPA Pilot Representatives for Retirement Pay Losses:* The Accounting Department is following the requirements of this resolution.
- *Legal Cost Reimbursement (FTL):* Completed.
- *Legal Cost Reimbursement (PAA):* Completed.
- *Membership Fees for Technical Societies:* Requirements of this mandate are being followed.

The following Convention actions, confirming past policy and establishing new policy, are being followed by the Accounting Department as adopted:

- Departmental Budget;
- Distribution of ALPA Financial Reports;
- More Streamlined Accounting Procedures;
- Income Tax Exemption of Foreign Station Allowance;
- Automatic Monthly Payment of Per Capita Allowance;
- Members in Good Standing Still Owing Strike Assessments and Possessing Current Flying Cards;
- Strike Assessment Payments by Supervisors (Interpretation of Retroactive Application);
- Revised Strike Benefits.

Membership And Affiliations

- *Membership Consideration for National Air Lines Strikebreakers:* The "recommendations of the Local Executive Council involved" have been received and the Executive Committee will report its recommendations to Board at 14th Convention.
- *Reinstatement to Active Membership of NAL pilot E. J. Kershaw:* Mr. Kershaw is now an active member in good standing.
- *Vote of Appreciation for Charter Members:* Preparation of a plaque listing charter members is in work.
- *ALPA Affiliation with A. F. of L.:* This policy is being followed.

Seniority, Interchange, Insurance And Retirement

- *Association Merger Procedures:* The merger procedure is being followed and was implemented in two mergers since the 1954 Convention (Pioneer - Continental, Eastern - Colonial).
- *PAA-PANAGRA Trackage:* Agreement has been reached between the PAA and Panagra pilots which is being implemented by collective bargaining. Association policy on this entire matter was developed by the Study Committee and approved by the Board of Directors.
- *Seniority or Longevity on ALPA Duty:* The Home Office has brought this matter to the attention of negotiating committees but to date no negotiating committee has accomplished the inclusion of such provision in the employment agreement.
- *ALPA Employee Retirement Program:* Completed.
- *Loss of License Insurance:* As required, this insurance was reviewed and a report made to the Board of Directors as stipulated.
- *Study Committee for Insurance Programs:* Activated and ready to report at 14th Convention.
- *Report of Advisory Committee on Retirement Problems:* Nineteen retirement programs covering 76 per cent of the membership have been negotiated since the 1954 Convention. These programs are consistent with the policy developed.

General Policy And Actions

- *Bronze Bust of David L. Behncke:* Completed.
- *ALPA Picketing Policy:* As a reaffirmation of previous policy, this resolution required no action other than compliance.
- *Strike Planning:* Reaffirmation of previous administrative practice. We continue to follow it.
- *Report to Convention on System Board Cases:* Reaffirmation of previous administrative practice. We continue to follow it.
- *Responsibility of Association in Upholding Arbitration Awards:* A policy guide for Association officers. Being followed.
- *Review of Policy Manual:* Activated and ready to report to 14th Convention.
- *Permanent Certification of Local Service Carriers:* Accomplished by Act of Congress for all local service and territorial carriers except for States-Alaska routes.
- *Study Committee for Developing Improved Workmen's Compensation:* The findings of this Committee have been reported to the Executive Committee as required.
- *Study Committee on Physical Standards:* Activated and reporting results to the 14th Convention.
- *Third Flight Crew Members:* Policy guide being adhered to by Association officers. Four additional airlines have altered their policies to conform with ALPA policy in the past two years.
- *Universal Postal Union Rates:* This measure has been supported by ALPA before the Congress but has not been successfully enacted as yet.
- *Congratulatory Message to Hawaiian Air Lines:* Accomplished.

Engineering And Air Safety

- *Clearance Between Aircraft Under VFR:* ALPA has worked with the CAA and Industry representatives to further this resolution through experimental high density area program in Washington, D. C., and approval of a draft release on this subject. The use of an airborne automatic warning device to prevent mid-air collisions has been backed by ALPA representatives in industry meetings. Such devices are presently being developed.
- *Extension of Air Route Traffic Control to All Routes and Airports:* Progress is being made in extending air route traffic control to all routes and airports. Industry committees have been made aware of this ALPA goal. Congressional action stimulated, and a White House study is underway.
- *Radar Traffic Control:* During industry discussions on radar traffic control, ALPA representatives are continually emphasizing the need for radar as a safety aid in traffic control, at the same time reducing emphasis on radar

increasing the volume of traffic management.

▶ *Radar as a Primary Approach Aid:* ALPA continues to emphasize that ILS should be considered the primary approach aid with PAR as a secondary aid usable as a primary aid only if ILS is inoperative. The need for high qualifications for CAA radar operators is continually being emphasized.

▶ *Radar Monitoring:* ALPA is continually reviewing the use of radar as a monitoring device during instrument approaches and will continue to subject them to review.

▶ *Association Policy on "Take a Look" Privilege:* This subject has been discussed with the CAA and CAB by ALPA's Committee on Operational Problems that meets with the CAA periodically in Washington, D. C., and indications are that representatives of the CAA and the CAB are gradually realizing the validity of the ALPA position, but more time will be needed to obtain industry approval of ALPA position. The policy is continually emphasized to ALPA members.

▶ *Temperature and Humidity Accountability:* ALPA's position of "100 per cent temperature and humidity accountability" has been continually presented in Airworthiness discussions on present aircraft, as well as jet type aircraft. Progress is becoming apparent, especially in the proposals being studied for jet aircraft operating requirements.

▶ *Fuel Storage in Air Line Aircraft:* The ALPA objective of moving fuel as far from the aircraft fuselage as possible has been presented at discussions with manufacturers of jet type aircraft and has resulted in additional safety considerations for the elimination of fumes and fuel leakage into the cabin. Although complete success has not been obtained, it is believed that this resolution has aided in improved design of new air line aircraft.

▶ *Installation of Flight Recorders:* ALPA has made known its approval of gust load flight recorders, but so far has been unable to obtain a requirement in the regulations of such equipment. This equipment is being used extensively, however, in newer aircraft types and it is believed that ALPA backing will continue to increase the amount of usage of such equipment.

▶ *Airborne Radar:* ALPA's support of airborne radar nationally and through the efforts of individual pilot groups in discussions with their management has stimulated a number of air lines to install radar in their present and future aircraft. At least one air line will have its fleet 100 per cent equipped with radar in about one year.

▶ *Ground Radar for Thunderstorm Avoidance:* Liaison has been continuing with the Air Defense Command. It is believed that progress is being made in utilizing Air Defense Command Radar for thunderstorm avoidance.

▶ *Prototype Airplane for the Local Service Carrier:* ALPA is encouraging the development of prototype aircraft suitable for local service type carrier operations by participation in evaluation discussions with Fokker and Fairchild in the development of the F-27 airplane. ALPA has been consulted by the Frye Aircraft Company in their development of the Safari airplane. This project has also been supported in the Congress, and ALPA is represented on the Federal Prototype Committee.

▶ *Visual Aid Airport Qualification:* ALPA has reviewed from time to time developments in visual aid to airport qualification procedures and have made this information available to the Civil Aeronautics Board. Presently the Association is monitoring the temporary regulations in operation which permit the use of visual aid to airport qualifications under specific conditions, and will continue to survey this procedure.

▶ *Six-month Instrument Proficiency Check:* The philosophy of this resolution has been discussed with the CAA, a number of carriers, and in industry speeches and meetings. Some progress has been made with certain air lines in this matter. It will take continued effort to satisfactorily complete this resolution at the air line level. At present there is no Civil Air Regulation that requires or prohibits the ALPA recommendation.

▶ *Serving of Liquor on Aircraft:* Demands were made on the air lines and Civil Aeronautics Board to abandon this practice. This failing, ALPA was successful in having bills introduced in both houses of Congress to abolish the practice. The House of Representatives passed the bill (HR 8000) but the Senate did not take action. It is believed that valuable groundwork was laid for future legislative action. In the meantime, because of mounting Congressional pressure, voluntary industry discipline was agreed upon to limit liquor service to two drinks per passenger not to exceed 1½ ounces. Six air lines now serve liquor on some flights, and the spread of the practice seems to have been halted.

Current Problems And The Future

As this report demonstrates, the Association, since the last Convention in 1954, has increased the income and improved the rules and working conditions of the air line pilots it represents, has increased its assets, and has increased its membership. Were the Association merely a business, we could summarize by saying that the last two years have been very successful. However, current and future problems fundamental to the continued strength and success of ALPA should be brought to the attention of the delegates to this Convention.

Solving Problems Of ALPA

As indicated by this report, the Association currently consists of the pilots on 47 air lines separated in 133 Councils. These Councils are scattered throughout the United States and a number of foreign countries. Pilots are individualists and hold strong views.

The aviation industry has grown tremendously in recent years in size and complexity. It is rapidly becoming one of the largest industries in our economy. Many air line companies who but a few short years ago were small corporations, now are gigantic enterprises employing over 20,000 people scattered over the world, of whom 1,500 or more are pilots.

As the industry and the Association have grown in size and complexity, so have the problems which must be solved, if we are to maintain and enhance the position of the piloting profession in this industry and in our overall economy. Therefore, despite the diversity of the many pilot groups making up ALPA, strong opinions held by individual pilots, and the complexity of the problems to be solved, we must develop overall consistent Association policy that will enable us to move forward in the general welfare. This is a difficult undertaking. It requires procedures which are carefully worked out so as to give each group of pilots an opportunity to participate in policy-making. It must subject complex problems to prolonged research and study by which the best minds, both within and outside the Association, are brought to bear on the particular problem. The results of such studies must then be subjected to scrutiny by the

pilot representatives in order that they will stand the test of pilot acceptance.

It is noted that the foregoing procedures are being utilized in increasing measure by ALPA as the Association has grown and matured. Complex problems and a number of those coming before this Convention are subjected to long-term study by Standing Committees of the Board of Directors. These Committees are composed of individuals selected by the pilot group as having outstanding ability and experience in the particular field. The Committees then go to the sources of the best available information or engage research people to help them in their deliberations. The Committees having no authority to act, their recommendations are then made available to the Board of Directors for such disposition as the Board of Directors see fit. It has been found that by utilizing this procedure, sounder policy in the overall interest of the Association has been promulgated and a greater measure of agreement achieved. Such policies are based upon study and fact rather than emotion.

It was not many years ago that Conventions were held with no advance announcement of the agenda, no spadework having been done by Standing Committees, and resolutions were adopted from the floor without previous study and based entirely upon immediate impressions. As a result, respect for policies of the Association by its own members and outside groups was not achieved. In recent years, a more deliberate development of policy has enabled the Association to enforce and carry out policy determinations in such a manner that Association policy has earned a new respect, not only from our membership, but also from outside agencies with whom we work in the transaction of our everyday business.

In view of the success that has been achieved with the foregoing procedures, it is our recommendation that they continue to be utilized as a means of resolving complex problems facing the Association.

Membership Participation

ALPA's Constitution and By-Laws were completely reviewed and revised as the result of intensive investigation and study by the Board of Directors and pilot committees beginning in 1950 and culminating in the adoption of revised By-Laws and a reorganized Association structure by the Board of Directors in October of 1952. At the last Convention in 1954, some changes were made which contributed significantly to the improvement of our organizational structure. However, we have encountered problems associated with the increased size of our membership and the expanding scope of our activities which suggested that further changes might be necessary in order to accommodate our structure to current and anticipated activities on behalf of the membership. On February 1, 1956, the Board of Directors approved a recommendation of the Executive Committee that a standing committee be appointed to review this problem. That committee will present its findings and recommendations to this Convention. It is urged that you give their recommendations your careful consideration with a view toward improving the representing capacity and procedures of the organizational structure.

On the whole, our organizational structure makes ALPA probably the most democratic institution of its type in the United States. This is desirable. Every member of this Association should have an opportunity to participate in the decisions which are made affecting his welfare.

In connection with the foregoing, the following statements were included in the writer's report to the 1954 Convention. Since the philosophy contained therein is equally applicable today, it is included for your information.

"However, democracy is not anarchy. The theory of democracy, upon which institutions under the American form of government have been constructed, is that of the 'Consent of the governed.' It is a representative form of government. The membership is represented by officers of their own selection. Procedures of the Association are kept open so that the membership may, if they feel it necessary, reverse or alter the direction in which their elected representatives are taking them. In this manner, representatives are kept responsible to their constituents.

"The foregoing does not mean, however, that elected representatives should not demonstrate leadership. The theory of government by the 'consent of the governed' is that the elected representatives take the responsibility to act as leaders and may do so as long as they receive the consent of the governed.

"In connection with the foregoing, several factors are necessary to a healthy organization:

- The membership must be active, informed and must participate in elections and decision making. If they are not active, then they are conceding that they will accept government by the minority who are active and who may or may not be representative.
- The membership must be furnished with factual and accurate information on which to base their decisions. However, it is not enough that information be furnished to them. The membership must also study and assimilate it and so their interest must be stimulated. The elected representatives must respect the will of the majority while respecting the rights of minorities. They must be strong, however, in resisting the pressure of minorities who seek to gain their ends by other than the processes which have been established.
- This is not as simply a matter as it may appear. Democratic processes and compliance with the will of the majority requires self-discipline. Some of our members are still reluctant to impose self-discipline upon themselves. They feel strongly about their rights as members but are unwilling to respect the rights of other members. They feel strongly about their rights as individuals, but do not respect their responsibilities as members of a group."

Responsibility

The Association must continue to enhance its reputation as a responsible spokesman for the air line piloting profession. This may be attained only by the governing bodies of the Association adopting sound and workable policies for the guidance of the Association officers and employees and standing behind such policies once adopted. The air line pilot holds a position of great dignity, authority, and responsibility in the air transportation industry. The decisions of his Association carry great weight and it is, therefore, the responsibility of the organization to use its authority wisely. This position carries with it an obligation to study problems in an objective manner, to be consistent, and to develop policies which will provide a satisfactory method of accomplishing desired and honorable objectives.

We desire to caution the delegates to this Convention, as we did the delegates in 1952 and 1954, that any policy adopted here will be administered to the best ability of the ALPA officers and staff. Irresponsible resolutions are capable of causing great damage to the air line pilots' prestige and integrity, as well as the aviation industry itself. The tremendous responsibility and authority which you possess, carries with it a responsibility to use it wisely for the general welfare. We ask, therefore, that you give every problem brought before you serious, objective consideration.

Stability

In addressing the 1954 Convention, I said that, "An effective institution must have continuity and stability in its functions. Sporadic participation in projects or activities does not make for progress. The Association must exist as a stable, consistent, and responsible institution capable of sustained effort in behalf of the profession. In order to accomplish this, continuity in pilot representation and policy must be achieved." These remarks are, in my opinion, equally applicable today. The Association must have long-range goals and objectives. Our policies cannot be radically altered each year or the result will be lost effort, a confusion of objectives, and a loss of respect. This does not mean that we should become hidebound, bureaucratic, or incapable of change. It does mean that we should carefully consider all developments of policy in terms of the long-range welfare of the professional air line pilot and be willing to support that program to achieve the stated objectives.

In order to achieve stability, a consistent financial program with adequate reserves is necessary. A program that will enable the recruitment and maintenance of skilled and able personnel is necessary. A continuity in the policy development of the various pilot groups through their Master Executive Councils is necessary. A continuity in pilot representation at the Local Council level, the Master Council level, on special projects and in Association offices is necessary. Certain recommendations will come before this Convention that are designed to increase the stability and continuity of Association policy to carry out its objectives. We endorse those recommendations.

Solution Of Internal And Intra-Association Problems

In addressing the 1954 Convention, I said that, "Sound procedures for the solution of internal problems in the Association must be found and maintained. The dignity of the air line piloting profession does not admit of the organization's becoming a public spectacle each time an intra-pilot problem appears on an air line or between air lines. The solution of internal problems (such as the integration of pilots' seniority lists) within the framework of ALPA procedures strengthens the ability of the organization to represent the entire membership and advance the common good. Such procedures should be strengthened and streamlined." In retrospect, it is evident that these remarks are also applicable today. We have resolved a number of our most serious internal problems between pilot groups which existed five or six years ago. We have developed procedures under which many of these problems may be handled. It is inevitable that such problems shall exist from time to time and the Association must be capable of resolving them in the interest of achieving harmony between the various pilot groups and within each pilot group. It is urged, therefore, that you give the most serious consideration to recommendations coming before you that will achieve this objective.

Respect For The Profession

In addressing the 1954 Convention, I said also, "The personal dignity and financial security of the air line pilot is dependent upon the respect which his fellow man holds for his profession and which he, himself, holds for it. It is imperative, therefore, that the representing organization for this important profession command the highest possible level of respect and dignity. Even more important, however, is the value which the pilot himself places upon his profession and the respect which he commands as the result of his professional and personal actions. It is important that in the policy-making work of this Association, every possible step be taken to insist that members of this profession maintain the highest possible respect for it." These remarks are also applicable today. You will have coming before you during this Convention a number of items dealing directly with the professional status of air line pilots. We urge that you give these items every possible consideration in the long-run interest of the welfare of the piloting profession.

Attitude

As the 14th Convention of the Air Line Pilots Association convenes to consider problems and programs for the future welfare of air line pilots, we should reflect for a minute on the position in which we find ourselves to face such problems. By and large, the record is good. Our membership is at an all-time high. The delinquency among our members is at an all-time low. Our financial reserves are the highest in our history. We have no outstanding obligations. Our staff has been increased in numbers and in training to cope with our increasing problems. The reservoir of pilot representatives who are experienced in the representation problems has been increased. Therefore, although we are aware of the many problems which are facing us in the immediate future, we can face them with confidence, for we have a firm foundation on which to build.

We are gathered here to review those problems, to review our capacities to cope with them, and to define our objectives in finding solutions to them. This is our assignment as we accept the trust that has been placed upon us by our fellow pilots.

In accepting this trust and gathering here to find solutions to our problems, we should reflect for a minute on the nature of ALPA. ALPA is not a building, or a person, or an impersonal institution to which you pay dues and in return you receive certain benefits. ALPA is an Association of professional air line pilots who have contracted together to promote the common welfare of themselves and their families. As is proper, they have retained in their own hands the authority to determine the course of action that will best promote that common welfare and have elected you as representatives to lead them.

Air Travel: It's Still Going Up And Up

Eight Cities Originate Over A Million Passengers

Detroit and Atlanta have joined the ranks of cities originating more than a million air passengers in the fiscal year, according to "Air Commerce Traffic Pattern, Fiscal Year 1956," recently published by the Civil Aeronautics Administration, U. S. Department of Commerce.

The report shows New York, Chicago, Los Angeles, Washington, San Francisco, Miami, Detroit and Atlanta produced more than a million passengers in fiscal 1956. The first five had that record in fiscal 1954, and Miami passed the million mark in fiscal 1955.

The CAA considers a city a "large" hub when it produces at least 1 per cent of the national total of passengers, which, in fiscal 1956 was 39,171,181. The following 22 cities are in this group:

City	F.Y. 1956	F.Y. 1955
New York	4,677,008	4,138,511
Chicago	3,841,632	3,335,074
Los Angeles	1,916,333	1,642,537
Washington	1,799,193	1,628,184
San Francisco	1,409,897	1,246,868
Miami	1,176,429	1,002,622
Detroit	1,105,224	957,251
Atlanta	1,058,619	950,925
Dallas	912,882	781,420
Boston	908,002	775,897
Cleveland	814,994	745,124
Pittsburgh	778,228	696,938
St. Louis	634,560	574,544
Philadelphia	587,160	491,703
Denver	580,302	536,765
Kansas City	555,120	500,718
New Orleans	554,858	477,492
Minneapolis	550,049	511,161
Houston	531,620	467,383
Seattle-Tacoma	517,856	469,138
Cincinnati	488,831	467,981
Buffalo	433,506	372,585

The four leading cities in tons of air cargo shipped in both fiscal 1955 and 1956 were as follows:

City	1955	1956
New York	56,998.0	62,877.9
Chicago	47,468.7	55,266.7
Los Angeles	26,434.5	29,706.7
Detroit	21,871.8	24,614.1

The Los Angeles, Chicago and New York metropolitan areas finished in that order in the tons of air mail on their scheduled helicopter services—the only areas with such services. Their figures are:

Los Angeles and connecting communities.

	Aircraft Departures	Passengers	Tons Air Mail	Tons Air Cargo
F.Y. 1955	29,410	1,951	3,249.9	496.3
F.Y. 1956	31,375	10,771	2,810.0	823.4

Chicago and connecting communities.

	Aircraft Departures	Passengers	Tons Air Mail	Tons Air Cargo
F.Y. 1955	36,228	None	1,570.6	None
F.Y. 1956	36,873	None	1,550.1	None

New York and connecting communities.

	Aircraft Departures	Passengers	Tons Air Mail	Tons Air Cargo
F.Y. 1955	25,994	15,165	924.5	642.4
F.Y. 1956	27,881	32,434	561.6	1,255.3

New York leads in the number of passengers enplaned for international and overseas trips. The standings are:

New York	404,329
Miami	312,644
Seattle	93,580
San Francisco	64,695
Los Angeles	59,955
Ft. Worth	40,175

The CAA points out that its program of airway construction and operation, and its Federal Aid Airport Program "need to be geared to the present and anticipated volume of air traffic by and between communities." For eight years these figures on air traffic have been assembled, and they have fallen into a pattern showing that a community's percentage share of the nation's traffic remains relatively stable. Variations are within acceptable limits for planning purposes.

Only changes in category between 1955 and 1956 were recorded by Bakersfield, Calif; Monroe, La.; Kalamazoo, Mich.; and Bradford, Pa., which moved up into the "small hub" category with more than 19,585 passengers each; Akron-Canton and Toledo, Ohio, which slipped to the small from the medium hub category, which requires more than 97,927 passengers; and Grand Junction, Colo., which dropped from the small to the non-hubs.

FLYER'S FORUM

A System For Tracking With The ADF

Maybe, Says The Author, You'll Get Sharp Enough To Make An ADF Approach With Your Teeth In

By Capt. O. B. Bivens
EAL

One of the greatest bugaboos of instrument flying seems to be ADF tracking. In fact almost every time the ADF is turned on, the cockpit becomes cluttered with bugaboos, big ones, small ones, medium sized ones, red ones, green ones, and so on, ad infinitum. The man, who two hours earlier at the previous station, bracketted the swinging leg of an old loop range with a 50-mile-an-hour cross wind and made a perfect 400 and one approach, now finds himself cleared for an ADF approach and proceeds with considerable dispatch and practically no gusto to wander all over half the sky, cross the station at an angle of 40° to the desired track, turn madly in the general direction of the airport, and then miss what might have been an easy approach. Why? Bugaboos? Gremlins? Nope. No system.

His System

"But I got a system!" he snorts, while trying with shaky hands to light a bent cigarette. "Why just last week I worked an ADF approach on this same place in the Link. I didn't get lost. I just remember that no matter what, when I turn the airplane to the desired track heading, the needle points in the direction of the track I want. It's simple that way. Then I always know which way to turn."

Sure, that's simple enough, and true, too. A Link Trainer is a very responsive contraption, and when a heavy foot is applied to the rudder, the result is a rapid change in heading that couldn't be duplicated in a large airplane. Result: hardly any time required for our hero to determine where his track lies. Consequently, when he gets confused and has to turn to the track heading in the Link Trainer, he loses very little ground to a stiff cross wind. But, when he straps all those engines and that flock of passengers to the seat of his pants, it's a different story. He can't kick all that weight around now. That big airplane just refuses to alter its course on the spur of the moment.

His range flying was smooth enough. He always knew which way to turn to get back to the leg. He never turned the airplane needlessly and consumed precious seconds flying the wrong heading. He didn't have to. The range signals told him where the desired track was, and he knew almost instinctively which way to turn. He had a system, a good system, and he practiced it diligently until it became second nature to him.

If you're an air line pilot or any pilot who does a lot of instrument flying, you probably have a system of track flying. Maybe it's a good one, maybe it's not. Maybe it's one of those that will work like a Swiss clock—if, and it's a big "if," you're a mental gym-

nast with an ambidextrous calculating machine for a brain. The author, alas, is not of this type. If you, too, are unfortunate, read on, brother. Here's a system that clicks like a brand new set of false teeth. Spend three or four hours on it in the Link or practice it as you fly, and before you know it, you're an expert. Never again will a check pilot or a CAA inspector laugh at you when you turn on the ADF.

Second Nature

Do you know your right hand from your left? Of course you do! If a check pilot says, "Give me a 180 to the right," you don't have to think to know which way to turn. You turn right. It's second nature, instinctive. If he says, "Turn left," you turn left. It's a habit. You learned left from right early in life. It became second nature.

When you make an instrument approach on a range station, you study the range chart beforehand. The chart tells you, among other things, where the A's and N's are with respect to the legs you intend to fly. You have to remember this information while you make the approach or you won't know which way to turn. Now if ranges never had north legs, or if you never flew into Canada where the quadrants may be reversed, A's and N's might become as natural to you as right and left. Flying southwest toward the station, you'd always have an N on your right and an A on your left. Flying southwest away from the station, you'd find the signals reversed with the A on the right and the N on the left. Then, knowing which way to turn when flying a range course would be almost as instinctive as turning right or left. The only thing you'd consider would be whether you were going to or from the station.

Not So Simple

Unfortunately, as we all know, things are not this simple. We have to bear in mind at all times during an approach on a given range station, whether the A is on the right and the N on the left inbound, or vice versa. After we pass the station, the vice becomes versa-ed around and the A's and N's swap sides. This gets a little confusing sometimes, especially if just as you hit the low cone, the stewardess pokes her empty little head into the cockpit, lifts up your right earphone, and shouts into your good ear, "Captain, I need a jug of coffee, and PULease find out if flight 603½ is going to hold for our connections!" Many a religious man has turned sinner at this point. In spite of all this most of us manage to do a pretty effective job with the old radio ranges. They've been here a long time and will probably be with us for some time to come.

"But looky here, Ernest Hemmingbird," mutters our hero, Philbert Phoggnudl, "I know all this stuff about ranges, but what's it got to do with any kind of system for ADF work?"

That's a good question, Philbert. Maybe at a glance you don't see much similarity between range flying and ADF flying, but there's one similarity we should agree on readily enough. Things work differently outbound than inbound. The A's and N's reverse on the range, and the needle on the ADF seems to behave in a different fashion when you pass the station.

The Difference

However, while placement of the A's and N's may differ from station to station, thereby requiring the pilot to keep in mind the individual characteristics of each station, the ADF always abides by the same set of rules regardless of the track being flown or the station being used. This should provide some advantage in favor of the ADF, if we can find some rules that are not too confusing.

Philbert's rule of turning to the desired track works and is not difficult to remember, but as we pointed out, it has some disadvantages, especially when tracking away from the station on final approach with a cross wind.

We've already established the fact that we all know left from right. Now if we could evolve a rule as simple as knowing left from right, and apply that rule to the ADF to tell us which way to turn, we'd take a lot of the confusion out of tracking. Let's quiz Philbert some more and see what happens.

Suppose you're flying west. You have the ADF tuned to a station somewhere up north of you. You continue west and leave the ADF tuned to this station. What happens to the relative bearings as you pass the station?

"That's simple, Doc!" replies Philbert. "They increase. You might start out with a relative bearing of 45° or 50°, and as you passed the station, the needle would swing through 90° and continue working its way around toward the tail. Numerically speaking, the relative bearings would be getting bigger."

Good show, Phil! You're a real scholar. Let's see how you do with the next question.

Same Situation

The situation is the same, but the radio station to which your ADF is tuned is located south of you. You're still flying west. What happens to the relative bearings now?

"Elementary, Mr. Snakesheare," comes Phoggnudl's ready answer. "They decrease. If you had a relative bearing of say, 315°, when you tuned the station in, the needle would travel counterclockwise through 270° as you passed abeam of the station."

The astute Mr. Phoggnudl is 100 per cent correct. *Any time we fly a straight course and pass a station on our right, the relative bearings on that station increase.* Conversely, *they decrease when we pass a station on our left.* This is a fact almost as simple and easy to remember as left and right, and it's just as basic, too. This is a rule we can use. Now, let's expand it a little.

Suppose your magnetic bearing on the station is 50°. Your desired track is 60°. Which bearing is larger?

"Whatta you trying to pull now?" growls the illustrious Phoggnudl, showing more than a trace of sarcasm. "My four year old kid knows 60 is bigger than 50!"

Excellent, Philbert, but watch your blood pressure. We're not being personal with this little quiz. We're only trying to establish basic principles, principles so fundamental that they will become habit with us and not tend to crop up later as confusing rules too complicated to remember.

"Oh, I see," says our mollified hero, displaying a sheepish grin. "You just said 'magnetic bearing on the station.' You were talking about relative bearings up to now. Why the switch? Everybody knows that you get *magnetic bearings* by combining relative bearings and magnetic headings."

Bearings—A Difference

Perfectly correct again, Phil, but remember that relative bearings and magnetic bearings *are* two different things. Your relative bearing is simply, as its name implies, the bearing on the station relative to the heading of the airplane. This is the bearing we said would always increase with the station on the right and decrease with the station on the left, provided we continued on the same heading.

Now, if the magnetic bearing is nothing more than the sum of the magnetic heading and the relative bearing, it must follow that as long as the heading does not vary, the magnetic bearings will act just exactly the same as the relative bearings when we pass a station. They, too, will *increase with the*

station on the right and decrease with it on the left.

This, then, will be our basic rule to remember. *If the heading is constant and you pass a station on your right, the bearings will increase. If you pass a station on your left, the bearings will decrease.* The application of this rule should be simple.

Consider your magnetic bearing at the moment as compared with the desired track. If your magnetic bearing is larger than the desired track, turn the airplane so that the station will be on your left. Your bearing will then decrease. *Bearings always decrease with the station on the left.* If your magnetic bearing is smaller than the desired track, turn the airplane so that the station is on your right, your bearing will then increase. *Bearings always increase with the station on the right.*

"Oh! I catch on now, Chief! You asked me that simple question whether 60° was larger than 50° so I'd know which way to turn to get on track. If my desired track is 60° and I've got a bearing of 50°, I'll have to get the station on my right to increase that 50 to 60. If I'm headed toward the station and make a left turn, the station will be on my right. Then the bearing will increase to 60°. That's simple enough, but what if I'm tracking *away* from the station? That's when I get mixed up."

That's when *most* pilots get mixed up, Philbert. But, if you bear in mind our cardinal rule, bearings increase with the station on the right and decrease with it on the left, you won't have any trouble. You see, *this rule applies whether you're flying toward the station or away from it!*

Cites Case

Suppose you're on a track of 50° *away* from the station, and your desired track *away* is 60°. Your bearing to the station would be 230° of course, but since we're not going to the station let's not complicate our thinking by using bearings *to* the station any more than we would think of our bearing to the station while we were tracking away from it. 60° is the desired track *away*. 240° would be the track to the station, but we don't care about that. We're not going that way. We're going to fly a track of 60° *away* from the station.

If your ADF is equipped with R. M. I. (Radio Magnetic Indicator), the tail end of the needle points to your magnetic bearing away from the station, which in this case is 50°. The head of the needle points toward the station and indicates 230°. If your ADF has the rotating scale which you can set manually to your heading, it, too, will read 230° on the head of the needle and 50° on the tail of the needle, assuming you have the scale set to your compass heading. Our bearing away from the station is 50°, and that is obviously less than our desired 60° track. To increase the bearing we know we must get the station on our right. Remember, your ADF always points toward the station regardless of your heading. *In tracking away from the station use the head of the needle to tell you which side the station is on. Use the tail of the needle to indicate the bearing away from the station.*

If, in this particular example, we begin with the airplane on a heading of 50°, our relative bearing will be 180°, or dead astern, as the seafaring man would say, but since we have the scale of our ADF set to our heading of 50°, we are not concerned with relative bearings. Therefore, the ADF does not indicate 180° relative, but instead, points directly at the tail of the airplane, and there we read the bearing to the station, 230°. The tail of the needle points to 50°, our bearing away from the station. We're not at all interested in 230°. We note only that the station is directly behind. That's all we want from the head of the needle. The 50° at the tail of the needle tells us our present bearing is too small. What happens if we turn right, say 30°?

Easy, He Says

"Shucks, that's easy!" exclaims the attentive Phoggnudl. "The ADF still points to the station which would now be on the right. I have an RMI on my airplane so I don't bother with relative bearings, but the station would be 30° to the right of the tail. My head would be 80°, and the bearing to the station would still be 230°. The bearing away from the station, reading off the tail of the needle would be 50°, but would start to increase as I approached the desired track.

"I see what you're getting at now. By noting whether the bearing away from the station is larger or smaller than my desired track, I can tell immediately without having to turn the airplane parallel to the desired track, which way I'll have to turn to get on the track I want. Going from the station, a right turn will put the station on my right and increase the bearings. A left turn will put the station on my left and decrease the bearings. With a little practice that ought to come pretty natural to me, but what happens when the wind starts to blow?"

That's another good question, Philbert. When the wind is blowing, you either correct for it, or you get fouled up. Your bracketting for wind is the same with the ADF as with the range station. You just take a big enough slice at the desired track to allow for any wind that might be affecting you.

Involved Factors

In the example we just ran through let's suppose we had a strong wind from the south which might have given us 15° drift to the left. When we turned to 80° to intercept our 60° track, we would have had 15° left drift. Therefore, our angle of interception would have been only 5°. With no wind, of course, the angle was 20° which would normally take us to the track with no trouble. If, after turning to 80° and flying that heading, we noted that the ADF needle was not progressing toward the desired track fast enough, we would immediately assume that we had a wind blowing us to the left, and would then turn still farther right to perhaps 90° or 95° to allow for this drift. This is exactly the same thing we'd do in flying a range. However, with the ADF we know how many degrees we are off the desired track. With the range we can only guess.

With a north wind instead of a south wind, we'd get perhaps 15° drift toward the desired track, and that added to the 20° bite our heading gave us would make an interception angle of 35°.

In your ADF work, treat the wind the same way you would when flying the ranges. Whenever possible, let the wind help you get back to your track, and by the same token, if you know the wind is opposing you, add enough correction to take care of the draft so that you don't parallel the track you want. Any time you turn the airplane to put the station on your right or left to increase or decrease the bearing, and the bearing stays the same, you are drifting. Excessive drift may even make the bearings increase when they apparently should decrease, or vice versa, but don't let this confuse you. If the station is on the right and the bearings don't increase, or if the station is on the left and the bearings don't decrease, there can be only one reason, wind drift. The cure is simple. Just make a larger correction, take a bigger bite at the desired track. As soon as your interception angle exceeds the drift, the bearings begin to increase or decrease just as they would with no wind.

"Bless my feathering pump!" exclaims Philbert, his blood-shot eyes beginning to glow with a new light. "I

see it all now! You had me worried for a minute when you said excessive drift might make bearings behave backwards, but I can see that as long as you kept comparing your magnetic bearings with your desired track, you couldn't get mixed up! If the magnetic bearing was too big, for instance, you'd know you had to get the station on the left to decrease the bearing. If the station was already on the left, but the bearing was not decreasing, you'd have to turn more and put the station closer to your wing tip in order to overcome the effect of the wind.

"Any more tricks to this system, Doc?"

Just one, Mr. Phoggnudl, just one. Suppose you have a relative bearing of 0°, a heading of 357°, and your desired track is 5°. This puts you on a bearing of 357° to the station. Which way would you turn to get on the 5° track?

Click, Click

Our hero's face appears blank for a moment and then thoughtful as the wheels begin to turn. As the gears mesh, the thoughtful expression changes to one of smug satisfaction. "You can just bet your Aunt Bessie's best bustle that you're not going to catch me on one like that!" he exclaims with all the zeal of a new copilot collecting a two dollar bet on a 100 to 1 shot the day before payday. "Those bearings are going to have to increase to change from 357° to 5°; 360 is larger than 357. Zero and 360 are the same thing on a compass, and 5 is larger than zero! You'd turn left and put the station on your right so the bearings could increase."

Brilliant, Philbert! Simply brilliant! Your knowledge of the compass rose tells you that all bearings increase around the rose in a clockwise direction from zero to 360 and then start over again. Since only 8° separate 357 and 5 on the scale in a clockwise direction, 5° must be like 365°, or 8° larger than 357°. You'd never turn the airplane the long way around just to change your heading by 8°. It wouldn't make any more sense to expect the ADF needle to go all the way around the scale to change from 357 to 5. After all, you're looking right at the ADF with the needle pointing to 357°. Just 8° clockwise you see your desired track of 5°. It's obvious at a glance that your magnetic bearing must *increase* to get to 5°, because it will have to go through 360° first. Otherwise it must decrease all the way around the scale to reach 5°.

"I'll buy the whole thing, Confucius," says Phoggnudl, taking a small can from his pocket and applying wax to the tips of his mustache. "Dang thing always wilts on me when I make ADF approaches! One time it drooped so bad I chewed one side clean off it on the final approach. Now I always take my teeth out when I turn on the ADF!

"Answer a couple more questions for me, Doc, and then I gotta run to keep an appointment with my bookie.

"Suppose I'm headed toward the station, and the check pilot says take up such and such a track away from the station. What's easiest way to start this problem?

Pointing Toward Track

In a case of this kind, Philbert, the old Phoggnudl system would probably be the simplest procedure to follow. Time would not likely be of the essence, and since the track to be flown is away from the station, turning the airplane to the heading of the desired track would get you into a position to begin the problem. *With the airplane paralleling the desired track, the ADF would then point toward that track.* From this position you could choose a heading that would intercept the track at whatever angle you wished. Once you reached the track, you would maintain your position along that track by turning to increase or decrease bearings in accordance with the system we have just outlined. You would not at any time after reaching the track be compelled to turn parallel to that track again in order to determine which way a correction should be made. The bearing comparison method would tell you everything you wanted to know. Just compare your bearing with the desired track to see which way to turn.

"I knew I had a system for getting on the track. All I needed was one to keep me on it!

"Now, how about the guy who does all this ADF work without an RMI? Do you recommend keeping the scale set to the compass heading all the way through the approach?"

The RMI

Before we go into that one, let's have a word or two about the Radio Magnetic Indicator (RMI). This flying game is almost as badly cluttered up with initials today as the government was during the days before World War II. Nearly everywhere a pilot goes he's plagued with initials, OBS, DME, DMI, PPI, PAR, VOR, VAR, etc., ad nauseum.

The Radio Magnetic Indicator, or RMI, is an attachment to the fluxgate compass and takes the place of the fixed or manually rotated scale on which the ADF needle operates. The RMI is synchronized with the direction indicator of the fluxgate compass, and therefore acts and looks like another compass. Since the fluxgate is gyro stabilized and indicates accurately without the lag and turning errors of the ordinary magnetic compass, the RMI follows suit. The ADF needle, or needles, if a dual ADF is provided, are superimposed over the RMI card. The relative bearings of the ADF needle are then read directly as magnetic bearings on the RMI. This desirable feature completely eliminates all the fuss and bother of keeping the ADF scale set to the compass heading.

Even though you may not have RMI equipment with your ADF, once you have reached the desired track, there is a simple method by which you can calculate magnetic bearings without the necessity of resetting the ADF scale every time your heading changes.

When you reach the track, set the rotating scale to zero and leave it there. If the relative bearing is zero, your magnetic bearing, naturally, will be exactly the same as your magnetic heading. If the relative bearing is on the right side of zero (clockwise), add it to the magnetic heading to get the magnetic bearing. If the relative bearing is on the left side of zero (counterclockwise), instead of reading it as 350° or 340°, for example, read it as 10° or 20° *left,* and *subtract* that number of degrees from the magnetic heading to arrive at the magnetic bearing.

Suppose your heading is 330° and your relative bearing is 15° right. 330° plus 15° equals 345°, the magnetic bearing to the station. If your relative bearing on the same heading has been 350°, or 10° left, the magnetic bearing to the station would have been 330° *minus* 10°, or 320°.

New Calculation

If you're tracking away from the station, calculate your track away in exactly the same fashion, but use the tail end of the needle.

Suppose your heading is 90°, and the head of the ADF needle indicates 180°. The tail of the needle must naturally point to zero; 90° plus 0° equals 90° which is your bearing away from the station.

With the same heading, 90°, and the head of the needle pointing to 190°, the tail would indicate 10°. 90° plus 10° equals 100°, your magnetic bearing away. Had your relative bearing on the

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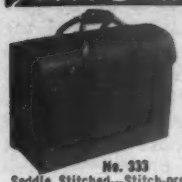

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same heading been 165° at the head of the needle, the tail of the needle would have pointed to 345°, or 15° left. 90° minus 15° equals 75°, your magnetic bearing from the station.

With the airplane established on or near the desired track, relative bearings will generally be quite small and easy to handle in this manner.

"Roger, Doc! And who knows? Maybe someday I'll be sharp enough with this bearing comparison stuff to make ADF approaches without taking my teeth out!"

Turbo Power Experience . . .

(Continued from Page 4)

rect power setting still applied, the airspeed will be reduced and time lost.

(c) If the W/V is more favorable than forecast, the aircraft will arrive over destination too high. Again time will be lost in shedding this excess height. The latter case is less costly in fuel if air brakes are fitted.

It is, therefore, imperative that descents are not commenced early, nor too late; either way costs fuel. The distance out from destination is a vital statistic for descent purposes and "Distance Measuring Equipment" should be considered as an essential requirement for routes off airways.

I mentioned earlier that the V.S.I. played a great part. On descents, this instrument becomes invaluable. If the rate of descent should be 2000′/minute, then any other rate will entail a fuel penalty in many cases.

A.T.C. can also cost you fuel, not only with delays in take-off clearance after engines are started, but by allowing a descent to low levels if a holding is probable. On the holding stack, the highest altitudes must be given to turbine aircraft. Pure jets should be stacked above turbo-props, and the descent should be made outside the stack.

You will have gathered from the foregoing that the Captain is going to be extremely fuel conscious. That is so, but it is equally important for the rest of the crew to be just as aware of the situation as the Captain. Such things as an increase in ambient temperature, which reduces the T.A.S., or a change in wind component which reduces the ground speed should instantly indicate fuel penalty to all the crew. For this reason I like an all-pilot crew, to whom airmanship is second nature. They can help the Captain because their reactions and trends of thought will be the same as his. They can thus almost anticipate his decisions and thereby save time in executing his orders.

▶ **Meteorological Conditions:** There are four things about weather which I have learned in the last few years which are worth passing on in connection with high flying.

(a) Cirrus cloud is just as extensive and dense and can be more turbulent than the stratus of the lower levels.

(b) That Cu. Nb. in the tropics often extend vertically to 60-70,000′. On occasions flying at 40,000′ past Cu. Nb., we were not much more than half way to the top. However, search radar has shown us that the only sections of Cu. Nb. which are really bad, are those which give ISO ECHO returns. The turbulence in the rest of the Cu. Nb. is fairly reasonable. We used to spend 30 minutes at a time going round and round inside the largest we could find. Since the turbine-powered aircraft is restricted in flexibility, search radar should be a pre-requisite, not only for safety reasons, but in order to reduce tension on the flight-deck.

(c) The jet stream plays a larger part in governing the success of a flight. Forecasting must improve in this respect. The forecasters will have to detect them with greater accuracy. It was not uncommon in the Mediterranean area to discover a wind of 160 Kts. and for the direction to change 180° with the same velocity, within an hour. Crews can help themselves by being ultra-suspicious every time they encounter turbulence, even if it is of only short duration. Changes of air temperature and drift are clues worthy of immediate investigation. The worst turbulence I have ever experienced, was over Europe in a jet stream of 190 Kts. in clear air.

(d) The fourth item, which unless designed out of the aircraft, can be a hazard, is windscreen misting. Quick descents from a great altitude where the ambient temperature may be extremely low, into warm, moist, lower levels, can cause misting to occur inside and outside the cockpit windows. Even if it is kept at bay for the landing, taxiing can become an unpleasant business. All manufacturers should treat this problem with the urgency it deserves.

Professional Standards...

(Continued from Page 7)

they are standards by which he may determine the propriety of his own conduct. Undoubtedly, interpretation of these principles will be required at times. As a rule, however, the pilot who is capable, honest, decent, courteous, and vigilant and who conducts his affairs in the light of his own conscientious interpretation of these principles will find no difficulty in the discharge of his professional obligations."

Summation

In recommending Professional Standards Committees at all levels of the Association, the Committee declared:

"As professional air line pilots we have a very definite responsibility to the traveling public, to our company, and to our fellow pilots to see to it that the standards of the air line piloting profession are maintained at the highest possible level. All air line pilots recognize this responsibility and are ready to accept it; the main problem involved is how best to see that it is carried out.

"As a professional group we must of necessity be a self-disciplining group. That is to say that we must establish our own standards of conduct and then make sure that we live up to them.

"The standards of conduct should be agreed upon by all of the air line pilots through the action of their elected representatives. After this is done there remains the problem of seeing to it that the agreed-to standards are upheld."

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